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MORPHOMETRIC CHANGES IN YELLOW-HEADED BLACKBIRDS DURING SUMMER IN CENTRAL NORTH DAKOTA

Daniel J. Twedt[1] and George M. Linz[2]

ABSTRACT.—Temporal stability of morphometric measurements is desirable when using avian morphology as a predictor of geographic origin. Therefore, to assess their temporal stability, we examined changes in morphology of Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) from central North Dakota during summer. Measurements differed among age classes and between sexes. As expected, due to growth and maturation, measurements on hatching-year birds increased over summer. Measurements of adult plumage fluctuated with prebasic molt and exhibited age-specific discontinuities. Body mass of adult birds increased over summer, whereas both culmen length and skull length decreased. Only body length and length of internal skeletal elements were temporally stable in adult Yellow-headed Blackbirds.

Key words: mass, molt, morphology, North Dakota, trend analysis, Xanthocephalus xanthocephalus, *yellow-headed blackbird.*

Morphometric measurements have been used to discriminate sex and distinguish age of several avian species (e.g., Bortolotti 1984, Gilliland and Ankney 1992), and morphometric techniques have been employed to assess geographic variation in birds (e.g., Zink and Remsen 1986, Aldrich and James 1991). Additionally, morphometric data have been used to describe subspecific differences (Benitez-Diaz 1993) and to suggest breeding locations of species encountered on wintering grounds (Ramos and Warner 1980) or during migration (James et al. 1984, Atwood 1989, Linz et al. 1993). For efficacy in detecting meaningful differences among the particular subgroups being compared, however, the morphometric characteristics used to distinguish individuals must be immutable over the time span during which specimens are obtained. We assessed temporal trends and discontinuities of selected morphometric characteristics of Yellow-headed Blackbirds from central North Dakota during summer to ascertain the suitability of these measurements for studies of geographic variation.

METHODS

From 28 May to 18 September 1987 and from 2 June to 18 September 1988, we collected Yellow-headed Blackbirds within central North Dakota (Benson, Ramsey, and Wells counties). We recorded external measurements (mass, total length, wing chord, and lengths of primary feathers, tail, and culmen) for all birds. Additionally, we recorded skull width, skull length, keel length, and tibiotarsus length from all second-year (SY) males, all after-second-year (ASY) males, all after-hatching-year (AHY) males, a subset of 100 hatching year (HY) males, and a subset of 56 AHY females. Because of the contribution of humerus and femur lengths to a discriminant model that differentiated female Yellow-headed Blackbirds breeding in the USA from those breeding in Canada (Twedt 1990), we also recorded these morphometric variables for all AHY females. Body length, for both females and males, was derived as the difference between total length and tail length. Yellow-headed blackbirds were aged by plumage characteristics (Pyle 1997), except after prebasic molt was complete, when we aged females by their bursa of Fabricius.

Recommendations of Baldwin et al. (1931) and Baumel et al. (1979) for morphometric measurements were followed. We recorded mass to the nearest 0.1 g. Wing chord, primary feather lengths, tail length, and total length were recorded to the nearest 1.0 mm, and all other measurements to the nearest 0.01 mm. Molt (loss and regrowth) of all primary feathers was similar, occurring sequentially from the 1st (innermost) primary (P1) through the

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9th primary (P9). For brevity, and because the 9th primary represents the termination of primary molt, we present data only for P9. Skeletal preparation followed Twedt (1990).

To test the null hypothesis that morphometric measurements were temporally stable, we used Kendall's rank correlation (τ) between each morphometric measurement and Julian date to detect monotonic trends through time (Kendall and Ord 1990). Lack of significant monotonic trend does not necessarily imply that the morphometric character is temporally stable. Indeed, a short-term trend may be followed by a similar, albeit reversed, short-term trend that results in the appearance of long-term stability of the morphometric characteristic. The discontinuities that result from reversal of short-term trends are indicative of morphometric characteristics that are temporally dynamic and therefore may be unsuitable for use in studies of geographic variation. To detect these discontinuities, we first estimated and removed significant linear trends in the data using 5-day moving averages (Kendall and Ord 1990). We subsequently used Webster's method (Webster 1973) to detect discontinuities in detrended morphometric data. To increase the likelihood of detecting all discontinuities, we used $\alpha = 0.10$ for Webster's tests.

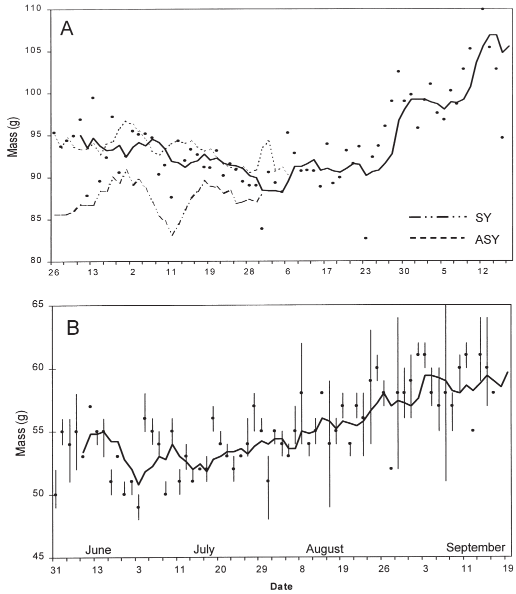

Fig. 1. A, Mean and 5-day running average of body mass for after-hatching-year (AHY) male Yellow-headed Blackbirds and 5-day running averages for second-year (SY) and after-second-year (ASY) males; B, mean ($\pm s_{\bar{x}}$) and 5-day running average of body mass for AHY female Yellow-headed Blackbirds. All birds were collected in central North Dakota during 1987 and 1988.

RESULTS

We collected 730 AHY females, 99 SY males, 723 ASY males, and 609 AHY males. After completion of prebasic molt (near the end of July), SY males were indistinguishable from ASY males; therefore, both were subsequently classified as AHY males. Although ASY males were significantly larger than SY males, morphometric data from both age classes exhibited similar trends over time (Fig. 1A). Therefore, we combined data from all adult males (AHY, ASY, SY) before trend analysis. Additionally, we collected 319 HY females and 518 HY males from late June, after they had fledged (Grimm 1968), until mid-September. Collections of all birds were dispersed throughout the summer, but peak numbers were collected from late July through August.

Adults

Body mass of AHY males exhibited a significant increasing trend ($\tau = 0.278$, $P < 0.01$) due primarily to mass gains during August and September (Fig. 1A). Similarly, AHY females exhibited an increasing trend ($\tau = 0.473$, $P < 0.01$) despite loss of mass during June (Fig. 1B).

Because of feather loss and regrowth during prebasic molt, tail length was highly correlated ($r = 0.85$) with total length. We detected significant increasing trends over the summer for total length of AHY females ($\tau = 0.252$, $P < 0.01$) and total length of AHY males ($\tau = 0.243$, $P < 0.01$; Fig. 2A). However, prebasic molt resulted in declines in both tail length and total length during July, whereas these measurements increased as tails regrew during August and September. After removing significant trends, the detrended data for AHY males revealed 2 significant ($t \geq 1.97$, $P \leq 0.07$) discontinuities on 19 and 26 July (Fig. 2A). For AHY females, only a single discontinuity on 19 July was identified for detrended total length ($t = 1.69$, $P = 0.09$). When tail length was removed from total length, the remaining body length was temporally stable for both AHY females ($\tau = 0.105$, $P = 0.22$) and AHY males ($\tau = -0.031$, $P = 0.75$).

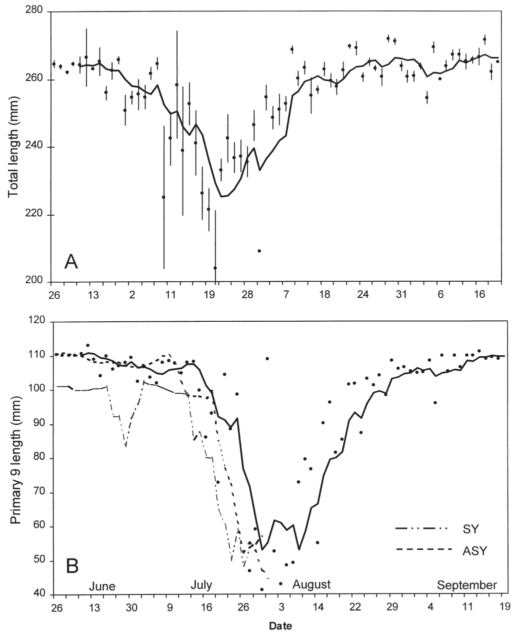

Fig. 2. A, Mean (± $s_{\bar{x}}$) and 5-day running average for total length of after-hatching-year (AHY) male Yellow-headed Blackbirds; B, mean and 5-day running average of length of 9th primary feather for AHY male Yellow-headed Blackbirds and 5-day running averages for second-year (SY) and after-second-year (ASY) males. All birds were collected in central North Dakota during 1987 and 1988.

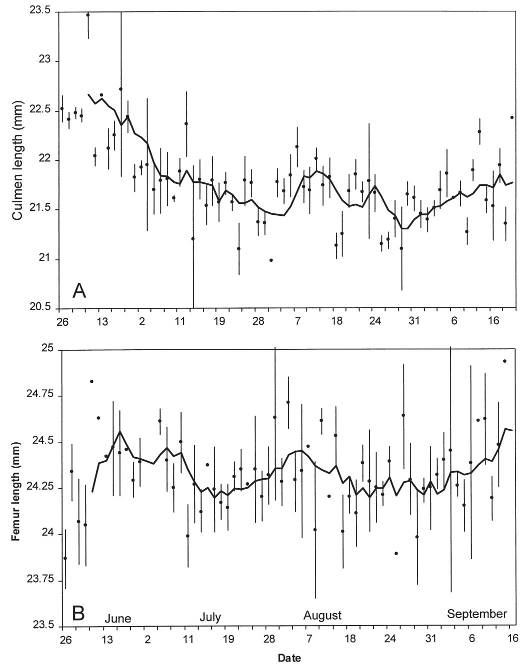

Fig. 3. A, Mean (± $s_{\bar{x}}$) and 5-day running average for culmen length of after-hatching-year (AHY) male Yellow-headed Blackbirds; B, mean (± $s_{\bar{x}}$) and 5-day running average for femur length of AHY female Yellow-headed Blackbirds. All birds were collected in central North Dakota during 1987 and 1988.

Although wing chord exhibited no significant trend over summer for either adult males ($\tau \leq 0.131$, $P = 0.10$) or females ($\tau \leq 0.107$, $P > 0.20$), both wing chord and length of the 9th primary had marked seasonal changes associated with prebasic molt. After these data were detrended, significant discontinuities were detected for females ($t \geq 2.04$, $P \leq 0.06$) on 26 July and 14 August and for males ($t \geq 1.80$, $P \leq 0.08$) on 29 July and 7 August (Fig. 2B).

Culmen length exhibited a significant decreasing trend (Fig. 3A) for both AHY females ($\tau = -0.218$, $P = 0.01$) and for AHY males ($\tau = -0.358$, $P < 0.01$). As culmen length was significantly correlated with skull length ($r = 0.84$), the decrease in culmen length over summer was mirrored by a significant decrease in skull length for males ($\tau = -0.289$, $P < 0.01$).

In AHY females, no skeletal measurement exhibited a significant trend over summer: skull width ($\tau = 0.091$, $P = 0.70$), femur ($\tau = 0.051$, $P = 0.54$), humerus ($\tau = 0.045$, $P = 0.60$), tibiotarsus ($\tau = 0.127$, $P = 0.59$), and keel length ($\tau = 0.091$ $P = 0.69$). Similarly, we detected no trends over summer for skeletal measurements of AHY males: skull width ($\tau = 0.001$, $P = 0.99$), tibiotarsus ($\tau = 0.048$, $P = 0.55$), and keel length ($\tau = 0.106$, $P = 0.43$). The consistency of skeletal measurements over time is illustrated by femur length of AHY females (Fig. 3B).

Juveniles

As expected for growing birds, both HY females ($\tau = 0.671$, $P < 0.01$) and HY males ($\tau = 0.543$, $P < 0.01$) exhibited significant increasing trends in body mass. These nearly linear trends represented an increase of 0.09 ± 0.01 g · day^{-1} for females and 0.11 ± 0.01 g · day^{-1} for males.

Because HY birds do not molt flight feathers during summer, measurements associated with plumage were not subject to midsummer discontinuities. Rather, these morphometric characteristics exhibited increasing trends due primarily to sharp increases during early summer as juvenile plumage completed growth. Even so, only HY males exhibited a significant increase in total length ($\tau = 0.398$, $P < 0.01$). However, as juvenile birds were not fully grown, body length of HY males also had an increasing trend over the summer ($\tau = 0.225$, $P = 0.03$).

As in AHY birds, wing chord in HY birds was correlated with the length of the 9th primary ($r = 0.7$). For HY males, the length of the 9th primary ($\tau = 0.475$, $P < 0.01$) and wing chord ($\tau = 0.431$, $P < 0.01$) increased over summer. However, nearly all this increase was in early summer, and plumage measurements were stable after July.

DISCUSSION

For adult Yellow-headed Blackbirds, the temporal dynamics of external measurements involving plumage are the consequence of prebasic molt, which begins in early July and culminates during early August (Twedt 1990). Thus, as feathers are lost in July, morphometric measurements decrease but then increase as new plumage grows. Comparison of the discontinuities found within detrended data on length of the 9th primary for AHY males with age-specific data on length of 9th primary indicates that these discontinuities are associated with age-specific differences in the timing of prebasic molt (Fig. 2B). That is, the peak of molt in SY males is approximately 7 days ahead of the peak of molt in ASY males. Although we did not differentiate between SY and ASY females, the presence of 2 similarly spaced discontinuities in the detrended data for length of 9th primary in AHY females suggests that an age-specific difference in molt is present and more pronounced in females.

For adult (AHY) birds, all skeletal measurements, other than skull length, were temporally stable. Body length of adults, both male and female, was also stable over summer. The decrease in culmen length and skull length over summer may have been associated with increased wear as birds shift from an insectivorous diet during spring to a predominantly granivorous diet during summer (Twedt et al. 1992). Alternatively, this decline in culmen length may be associated with protein shortages as nutrients are diverted from the culmen to feather growth during molt (Heitmeyer 1988).

For adult males and females, total body mass varied over summer. Initial mass loss by AHY females during June probably reflected the collective impacts of nesting and brood rearing. By the end of June, most young were fledged (Grimm 1968); therefore, the increased mass of AHY females in July corresponded with decreased parental responsibility. Marked deposition of premigratory fat, in both females and males, accounts for most of the mass gain during August and September. However, because birds that breed in Canada are, on average, larger (♂♂ 97.4 g; ♀♀ 59.3 g) than birds that breed in North Dakota (♂♂ 94.5 g; ♀♀ 55.3 g; Twedt et al. 1994), arrival of early migrant Yellow-headed Blackbirds from Canada could have exacerbated our observed increases in mass and length. Unfortunately, we were unable to reliably determine the geographic origin of individual Yellow-headed Blackbirds (Twedt 1990) so that we could eliminate this potential source of error.

Flight feather growth of most HY birds was completed by the end of July, whereas most AHY birds completed prebasic molt during mid-August. Thus, both adult and juvenile Yellow-headed Blackbirds were physically prepared for migration by mid-August. Therefore, the apparent decline in wing chord and length of 9th primary exhibited by females during September may have been the result of emigration of birds that completed molt, leaving only late-molting birds within the study area for collection and measurement.

Despite completed molt, the continued increases in body mass through the end of August suggested that these birds may not have been physiologically ready for long-distance migration until the last week of August, which is when most Yellow-headed Blackbirds begin to migrate from central North Dakota. This speculation on migratory preparedness is supported by banding returns (Royall et al. 1971) and by our observations on numbers of Yellow-headed Blackbirds within central North Dakota. These birds declined precipitously in numbers during August and early September such that by mid-September nearly all Yellow-headed Blackbirds had departed. Conversely, Red-winged Blackbirds (*Agelaius phoeniceus*) and Common Grackles (*Quiscalus quiscula*), with which Yellow-headed Blackbirds formed feeding associations and communal roosts, remained in relative abundance within central North Dakota through September.

The temporal instability of most external morphometric measurements, including skull length and culmen length, indicate that when using these measurements in comparative studies, consideration must be given not only to age and sex of the specimen but also to time of year in which birds are sampled. Accordingly, discrimination among different subgroups using temporally dynamic morphometric data may be confounded when subgroups being compared are collected during different seasons. Conversely, skeletal measurements were relatively stable over the duration of our study. Thus, only these temporally stable measurements are suitable for development of morphometric models that can be used throughout the summer.

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LITERATURE CITED

ALDRICH, J.W., AND F.C. JAMES. 1991. Ecogeographic variation in the American Robin (*Turdus migratorious*). Auk 108:230–249

ATWOOD, J.A. 1989. Inferred destinations of spring migrant Common Yellowthroats based on plumage and morphology. Pages 377–383 *in* J.M. Hagan III and D.W. Johnston, editors, Ecology and conservation of Neotropical migratory landbirds.

BALDWIN, S.P., H.C. OBERHOLSER, AND L.G. WORLEY. 1931. Measurements of birds. Volume 2. Scientific Publication, Cleveland Museum Natural History.

BAUMEL, J.J., A.S. KING, A.M. LUCAS, J.E. BREAZILE, AND H.E. EVANS. 1979. Nomina anatomica avium. Academic Press, New York. 165 pp.

BENITEZ-DIAZ, H. 1993. Geographic variation in coloration and morphology of the Acorn Woodpecker. Condor 95:63–71.

BORTOLOTTI, G.R. 1984. Criteria for determining age and sex of nestling Bald Eagles. Journal of Field Ornithology 55:467–481.

GILLILAND, S.G., AND C.D. ANKNEY. 1992. Estimating age of young birds with a multivariate measure of body size. Auk 109:444–450.

GRIMM, L.H. 1968. Breeding success of the Yellow-headed Blackbird in Barnes County, North Dakota. Master's thesis, North Dakota State University, Fargo.

HEITMEYER, M.E. 1988. Protein costs of the prebasic molt of female mallards. Condor 90:263–266.

JAMES, F.C., R.T. ENGSTROM, C. NESMITH, AND R. LAYBOURNE. 1984. Inferences about population movements of Red-winged Blackbirds from morphological data. American Midland Naturalist 111:319–331.

KENDALL, M.G., AND J.K. ORD. 1990. Time series. 3rd edition. Edward Arnold, Sevenoaks, Kent, England. 296 pp.

LINZ, G.M., L.J. LINZ, J.M. THOMPSON, AND W.J. BLEIER. 1993. Using geographic variation to predict breeding locales of migrating Red-winged Blackbirds. Prairie Naturalist 25:127–133.

PYLE, P. 1997. Identification guide to North American birds. Part I. Slate Creek Press, Bolinas, CA.

RAMOS, M.A., AND D.W. WARNER. 1980. Analysis of North American subspecies of migrant birds wintering in Los Tuxtlas, southern Veracruz, Mexico. Pages 173–180 *in* A. Keast and E.S. Morton, editors, Migrant birds in the Neotropics: ecology, behavior, distribution and conservation. Smithsonian Institution Press, Washington, DC.

ROYALL, W.C., JR., J.W. DEGRAZIO, J.L. GUARINO, AND A. GAMMELL. 1971. Migration of banded Yellow-headed Blackbirds. Condor 73:100–106.

TWEDT, D.J. 1990. Diet, molt, and geographic variation in Yellow-headed Blackbirds, *Xanthocephalus xanthocephalus.* Doctoral dissertation, North Dakota State University, Fargo.

TWEDT, D.J., W.J. BLEIER, AND G.M. LINZ. 1992. Geographic and temporal variation in the diet of Yellow-headed Blackbirds. Condor 93:975–986.

______. 1994. Geographic variation in Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) from the northern Great Plains. Condor 96:1030–1036.

WEBSTER, R. 1973. Automatic soil-boundary location from transect data. Mathematical Geology 5:27–37.

ZINK, R.M., AND J.V. REMSEN. 1986. Evolutionary processes and patterns of geographic variation in birds. Current Ornithology 4:1–69.

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